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ABSTRACT

The goal of this teacher guide is to promote education by providing resources and information to aid classroom teachers in using the Oregon Zoo as an educational setting. The unit also emphasizes the integration of science, mathematics, reading, writing, speaking, and problem solving. It is designed for grades 3-5 and is based on the Oregon State Standards for 5th grade. The guide includes both Student/Teacher and Teacher Only pages. Topics include: (1) The Northwest Coast; (2) Tropical Coast vs. Northwest Coast; (3) Steller Sea Lions; (4) Sea Lion Adaptation Activity; (5) Sea Lion Measurement Activity; (6) Buoyancy Activity; (7) Comparison Activity; (8) Research Lab; (9) Food Web Activity; (10) Awareness Ideas; (11) Sea Otters; (12) Kelp Forest; (13) Food Chain Activity; (14) Kelp Forest Activities; (15) Tide Pools; (16) Tide Pool Activity; (17) Tide Pool Manners Activity; (18) People of the Rocky Coast Activity; (19) Making a Difference; (20) Visit the Zoo; (21) Zoo Worksheet; (22) Assessment Worksheet; and (23) Teacher Resources. (SOE)

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Steller Cove

Oregon Zoo
Teacher Resource Guide

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Written by Kristin Ward
Cover Photo by Patricia Gayle

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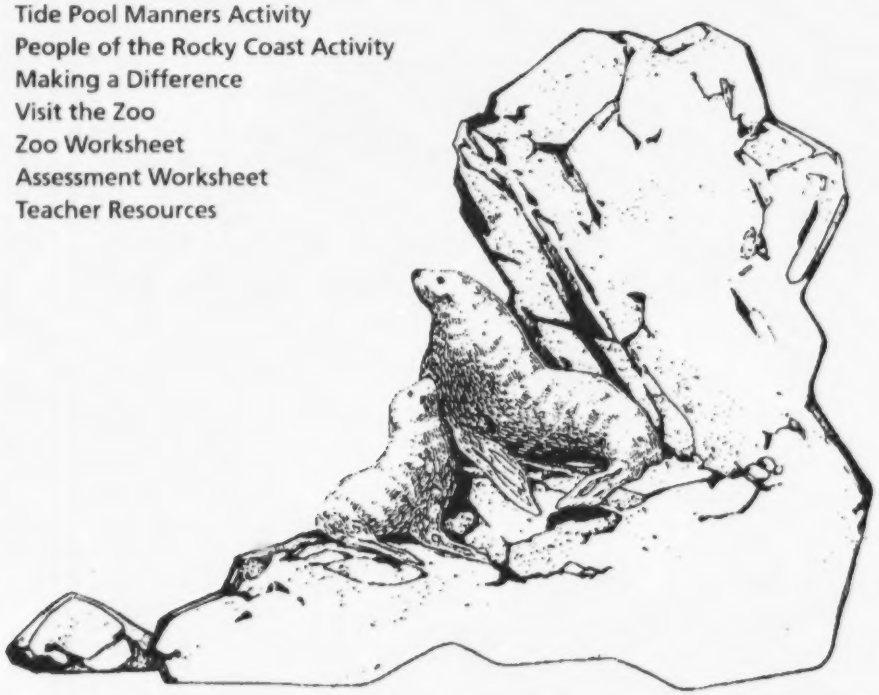


Introduction

The goal of the Oregon Zoo is to promote education by providing resources and information to aid classroom teachers.

This particular unit focuses on our lates cluding: science, mathematics, reading, writing, speaking and problem solving. We encourage teachers to use and modify this unit in order to best meet their students' needs.

How to use this unit:

Student/Teacher Pages — Teachers are encouraged to provide each student with a folder or journal containing the reproducible student/teacher pages within the unit. In order to conserve space, activity suggestions meant for the teacher have been added to the bottom of each page. We recommend photocopying these pages with the activity covered or removed so it is not copied onto the pages the student receives. The student/teacher pages are marked at the top with ***"Student/Teacher Page."***

Teacher Only Pages — There are a few "teacher only" pages in this unit that contain activities or other information meant only for the teacher to see (in addition to those also included on the Student/Teacher Pages). The "teacher only" pages are marked with ***"Teacher Only Page."***

Oregon State Standards

This unit is designed for grades three through five and is based upon the Oregon State Standards for 5th grade. In the area of science, this curriculum covers items in:

- Unifying concepts and processes
- Life science and scientific inquiry
- Calculations and estimations
- Measurement
- History
- Geography
- The arts
- Reading
- Writing
- Speaking and listening

Student/Teacher Page

The Northwest Coast

The Northwest coast offers a wealth of wildlife both in and out of the water. This rugged and varied coast has been home to both animals and people throughout its long history. Take a journey with the Oregon Zoo as we learn about the many marine animals that live off our coast, the Native Americans who lived along the shore thousands of years ago, and the people who are working to preserve the coast today.

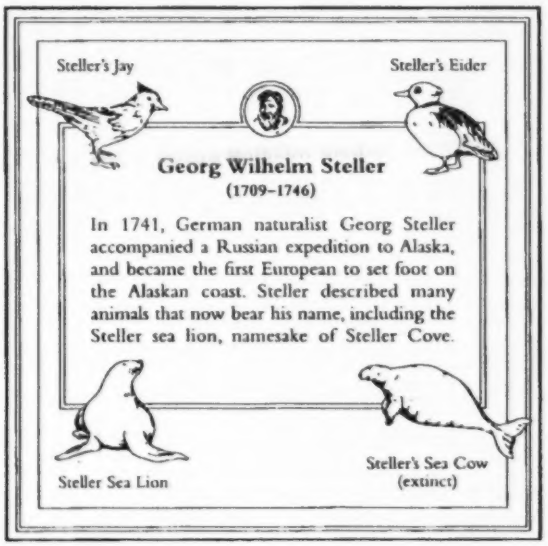
Vocabulary words:

buoyancy
ecosystem
extinction
habitat
pelt
pinniped
rookery
salinity
solitary
species
streamlined

The Northwest coast offers a unique ecosystem that forms a connection between temperate forests and the Pacific Ocean. Everything in this region finds its way into the ocean that borders our coastline. Water from rivers, fish and other water life, dead trees, pollution, it all moves through our coastal ecosystem. Good or bad, we all contribute something to this unique habitat.

Millions of creatures make their home in the ocean along the Northwest coast, some too small to see and others larger than you! Steller sea lions sun themselves on rocky outcrops. Sea otters dive through the kelp forests to find their dinner. A cabezon fish uses its camouflage and lies in wait among the seaweed for unsuspecting prey. A lined shore crab scuttles across the rocky tide pools avoiding a black oystercatcher swooping down from above. Each animal and plant is linked to others in this aquatic world.

Welcome to Steller Cove!


Steller's Jay
Steller's Eider
Georg Wilhelm Steller
(1709–1746)
In 1741, German naturalist Georg Steller accompanied a Russian expedition to Alaska, and became the first European to set foot on the Alaskan coast. Steller described many animals that now bear his name, including the Steller sea lion, namesake of Steller Cove.
Steller Sea Lion
Steller's Sea Cow
(extinct)

Student/Teacher Page

Tropical Coast vs. Northwest Coast

From the rocky beach to the temperate rainforest, the Northwest coast is unlike many throughout the world. Many people think of the coast as a place of sandy beaches and warm water, where you can lie out in the sun, swim or snorkel. However, among the 395 miles of Oregon beaches, 161 miles are rocky.

Tropical coastline

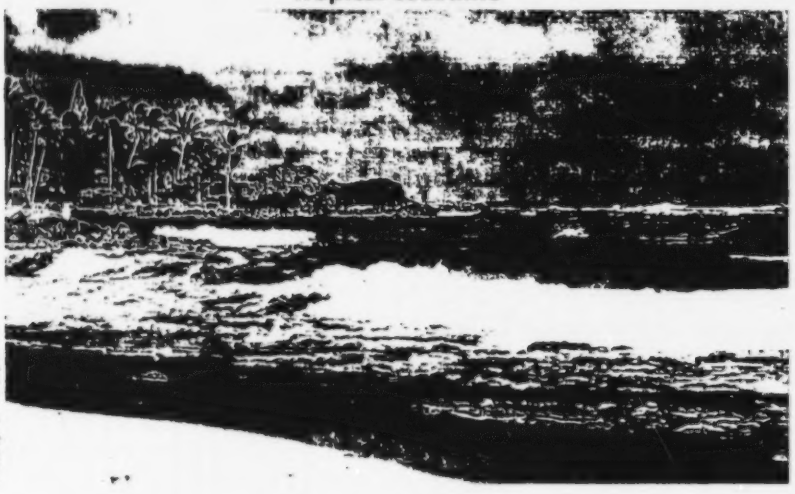


Photo by Patricia Gayle

Can you figure out what percentage of the Oregon coast are sandy beaches? What percentage are rocky beaches? Can you make a graph of this information?

Northwest coastline

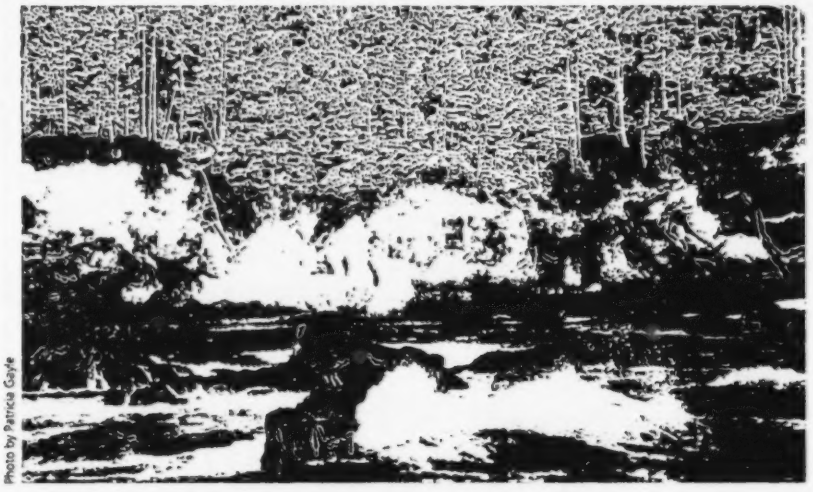


Photo by Patricia Gayle

Unlike a tropical beach, our coastline does not offer coral reefs and warm water. The current that borders our coastline brings with it water from Alaska. Water that is too cold for showy coral and flashy fish. Instead, we have a coast that teems with life in kelp forests and intertidal pools, and farther out, Orcas and sea lions.

Student/Teacher Page

Steller Sea Lions of the Northwest Coast

Steller sea lions inhabit the waters off the coast of the Northwest. They are well adapted to the cold, turbulent ocean.

Fun Fact:

Steller sea lions are pinnipeds—flipper-footed mammals that inhabit the world's oceans. Sea lions can use claws on their front flippers to climb rock walls, often climbing ten feet or more. Steller sea lions are part of the family called eared seals, pinnipeds whose ear holes are covered by external ear flaps.

Large muzzles and pointed teeth make them effective predators, allowing them to catch and hold slippery fish.

Slit-like nostrils that can open and shut enable the sea lion to swim without the risk of inhaling seawater.

Large eyes allow them to see and hunt in the murky water.

Thanks to a **thick layer of blubber** that lies just beneath their outer skin, Steller sea lions can withstand ocean temperatures that would numb our bodies in minutes.

Sensitive mustache-like whiskers have nerve fibers that help sea lions search for food in dark, deep waters.

The stream lined, torpedo shaped body allows the sea lion to move through the water at high speeds.

Flexible hind flippers that can rotate forward, beneath the body, make movement on land less of a chore.

Paddle shaped front flippers allow the sea lion to fly through the water reaching comfortable speeds of 18 mph—nearly eight times the speed of a human swimmer.

* Activity *

Before introducing the Steller sea lion, engage students in a discussion of the adaptations a sea lion would need to survive

Objective: This lesson introduces students to the adaptations of the Steller sea lion.

Materials: chart paper to record student responses, transparency of Steller sea lion.

Procedure: On chart paper write: If you were a sea lion, what would you need to survive? Probe for responses by asking the following questions: What do you think you might eat? How would you get your food? What parts of your body would you use to get food? Would you only live in the ocean? What would you use to move through the water? If you wanted to come on land, how would you do that? How would you keep warm in the cold ocean water?

Display the Steller sea lion transparency or hand out copies of Steller sea lion sketch and compare students' responses to the actual sea lion adaptations.

Student/Teacher Page

Steller Sea Lions Measure Up

A Steller sea lion can reach 11 feet in length and weigh 2,000 pounds. The males have tan-colored pelts and thick manes around their necks. A California sea lion can reach seven and a half feet in length and about 800 pounds. They make barking sounds and are characterized by their high foreheads. The Harbor seal is typically between four to six feet long and weighs 220-330 pounds. These seals are unable to walk on their back flippers like a sea lion can and therefore have to scoot on their bellies when on land.

Compare the pictures below.
How can you tell which pinneped is a Steller sea lion?

Fun Fact:

Steller sea lions are quiet in the water, but on land they sound out loud battle cries and warning calls to rival sea lions.

* Activity *

Objective: This lesson will give students a visual demonstration of the weight of a Steller sea lion.

Materials: chart paper
Procedure: Record student weights on chart paper. Have students estimate how many classmates they would need to equal 2,000 pounds. Add up figures until the total reaches approximately 2,000 pounds. Compare with student estimates. Ask students to gather in a group, pressing close together to demonstrate the mass of students that are needed to equal the weight of a Steller sea lion.

* Activity *

Objective: This lesson allows students to use non-traditional measuring tools and gives them a visual representation of the length of three pinnipeds.

Materials: yarn (multiple colors), tape measure, cut outs of Harbor seal, California sea lion and Steller sea lion.
Procedure: Have students guess how long a Steller sea lion is in proportion to their classroom. Ask two students to stand at the length the class feels a sea lion would measure. Next, using a different color of yarn for each animal and a tape measure, measure the length of a Harbor seal (5 feet), California sea lion (7.5 feet) and Steller sea lion (11 feet) and place the measurements on a wall with a picture and the animal's name next to each measurement. Measure the Harbor seal first, and then use its measurement as a base for the California sea lion and the Steller sea lion. See if students' size prediction was accurate. Extend the activity by measuring a few students to use as comparisons.

Hunters of the Deep

Steller Sea Lion Hunting Grounds

KEY:
- ● *Haul-out sites*
- * *Breeding rookeries*

The ocean has an abundance of food for the Steller sea lion. To maintain their thick coat of blubber, Steller sea lions hunt fish, squid and octopus. Their hunting grounds are off the coast where the water is cold and deep. Their blubber enables them to withstand frigid temperatures and their unique lung and heart functions allow them to dive to great depths in search of food.

Before a deep dive, a sea lion will expel the air from its lungs to reduce buoyancy. Their nostrils close, preventing any water from entering their noses and as the sea lion descends, the pressure increases and their lungs collapse. As the sea lion glides downward, its heart rate decreases from 120 beats per minute to four or six beats per minute over the course of the dive.

Fun Fact:

When sea lions dive to great depths, many organs shut down to conserve oxygen.

* Quick Activity *

How does your heart rate measure up to a sea lion's?

Procedure: Have students take their pulse at rest. Find their pulse in their neck and count the beats for six seconds. Multiply the number of beats by ten to find out how many beats per minute the heart beats at rest. Next, have students run in place for two minutes, then take their pulse again. Now they have their heart rate while at work. Compare to the sea lion's heart rate of 120 and 6 beats per minute.

* Activity *

Objective: This lesson introduces students to the concept of buoyancy.

What is buoyancy?

Materials: balloons, sand or rocks, clear glass or plastic tub of water.
Procedure: Tell students that they are going to do an experiment with buoyancy. On a piece of paper or in their science journals, have students write the word buoyancy and its definition. Explain to students that you are going to place sand (or rocks) in a balloon (use about two-three tablespoons of sand depending on balloon size) and then put the balloon in the tub of water. Ask students to write the questions: Will the sand filled balloon sink? Why or why not? Have them write their responses. Place the sand filled balloon in the water. Have students record their observations. Next, ask students to record the question: "What could be done to make the balloon more buoyant?" and their responses. Discuss some of their ideas before moving on. Test their hypothesis using new balloons for each test. Have students record their observations for each test as well as the specifics of each test. If they have not suggested filling the balloon with air, place sand in balloon and fill with air. To extend this activity, alter the depth of the water and gather various items from your classroom. Does the depth of the water change the buoyancy of certain items?

Student/Teacher Page

Steller Sea Lions and Their Pups

Steller sea lions live in noisy groups when on land and during breeding season can be seen in groups of 2,000 or more members. A male Steller sea lion, called a bull, gathers many females together to mate with in an area that is called a rookery, a stretch of shore that is a designated breeding ground. Sea lions will mate and raise their young in rookeries. Although it seems like an easy task for the bull, he must constantly fight and defend his females. A bull may issue loud barks and use his body to express a threat to his rivals. In some instances battles may erupt, but they are often brief.

The life of a female Steller sea lion is just as taxing as a male's. A female will often return to the same rookery year after year, often times it is the place where she was born. Most females are already pregnant when they arrive at the rookery, having carried the pup for a year.

Females usually give birth to one pup every season. A newborn pup weighs between 35 to 50 pounds. They are eager to drink their mother's milk, which has a fat content of 20 to 55 percent. The pups need this large amount of fat to build up their blubber and to sustain them for time periods as long as seven days while their mothers go out to sea to feed. Steller sea lion mothers are known to be very protective of their young during the first few weeks of life, often resorting to snapping at other sea lions that come too close.

As the weeks pass, the degree of protection lessens and many young pups die in storms and accidents in the rookery. At three months of age, Steller sea lion pups move out of the wading pools where they learned to swim and into the shallow surge channels near the shore. Pups love to play and spend many hours at mock combat, underwater racing and wrestling, and often times playing with pieces of wood, kelp, rocks and ice. These playful exercises are preparing the pups for their adult life when they will need to defend their territories and avoid predators.

Fun Fact:

A Steller sea lion pup drinks about two quarts of milk a day and can gain up to 12 ounces within 24 hours, doubling its weight in six to ten weeks.

Student Page

Steller Sea Lions and Their Pups

Name_____ **Date**_____

Compare the life of a Steller sea lion pup to your own:

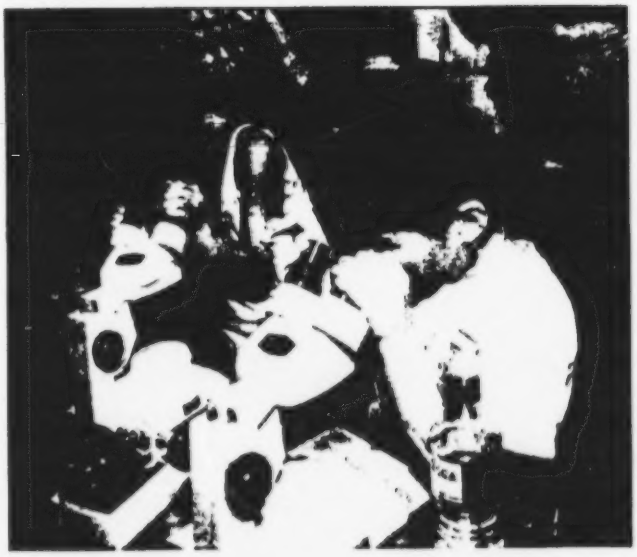
	Steller Sea Lion		You
Birth Weight	*35-50 lbs.*	**Birth Weight**	
Left Alone Without Mother	*A few weeks of age*	**Left Alone Without Parent**	
Learn to Swim	*Immediately*	**Learn to Walk**	
Games	*Mock Combat, Diving, Racing, Wrestling, Playing with chunks of wood, kelp, ice and rocks*	**Games**	

Please write two paragraphs about what a day in a Steller sea lion pup's life might be like.

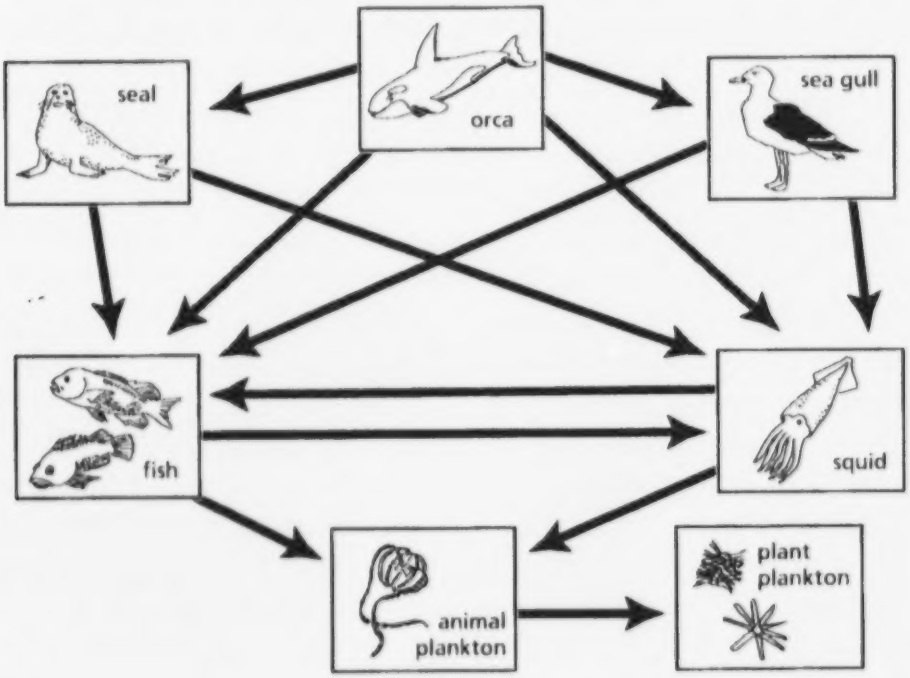
Student/Teacher Page

Become a Marine Biologist at the Oregon Zoo!

Here at the Oregon Zoo, we have a unique opportunity for you to act as a marine biologist. In our Marine Research Laboratory, you can find out what is happening with Steller sea lion populations today. Using a variety of research tools, scientists are tracking Steller sea lions, studying their hunting habits, analyzing food webs, researching local fisheries and investigating human impact. When you visit our research center, you can see first hand what is being done to protect these powerful animals.



Scientists are busy studying the Steller sea lions' habitats in an effort to find out how to keep these animals from extinction. One tool scientists use is the food web. A food web is a model that tells scientists the impact that different species of animals have on the Steller sea lion's diet. Here is an example of a food web.



Student/Teacher Page

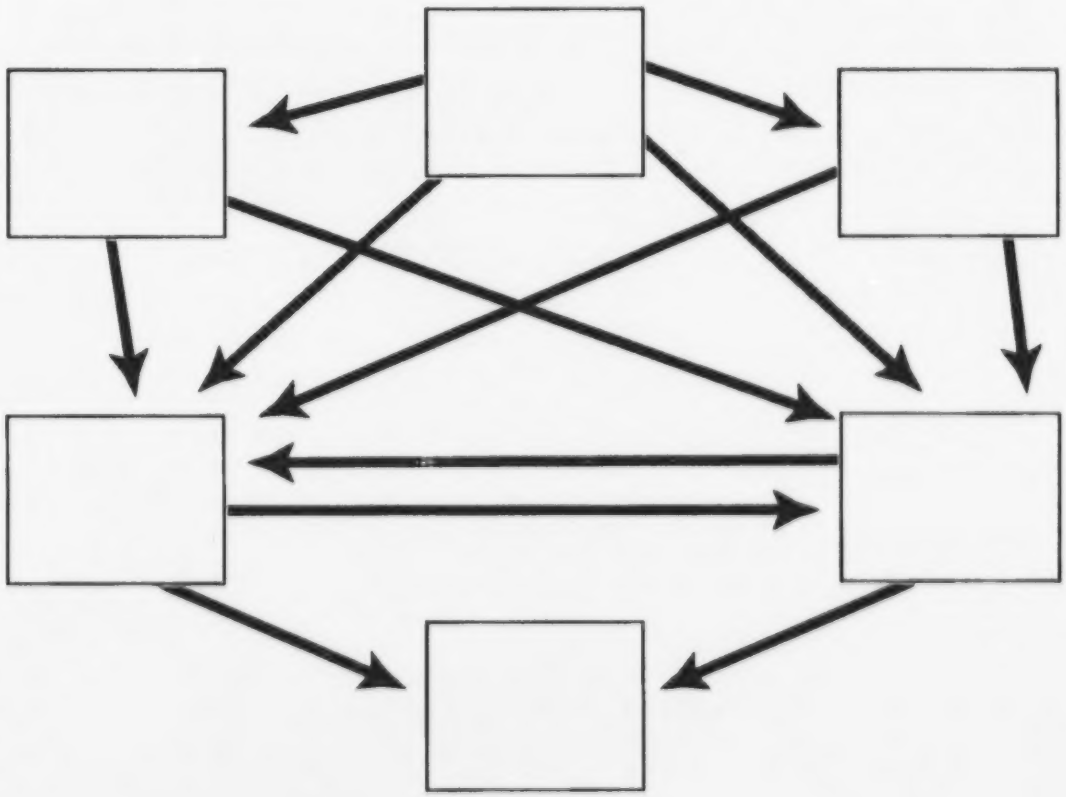
Become a Marine Biologist at the Oregon Zoo!

Name_____ **Date**_____

A Steller sea lion hunts squid, various fish and octopus. These animals, in turn, feed on other organisms. If one of the organisms that a squid eats begins to die off, what do you think will happen to the squid population? What might the Steller sea lions eat instead of squid? If Steller sea lions begin to eat more fish or octopus, what kind of impact will that have on those marine animals?

Each organism in the ocean is linked to another. If one organism dies off, there is a direct impact in the ocean environment. Research the animals that Steller sea lions eat and find out what those animals feed on, then fill in the food web below, using the Steller sea lion as the top predator.

Animal list: Orca, Steller sea lion, Shark, Fish, Squid, Plankton

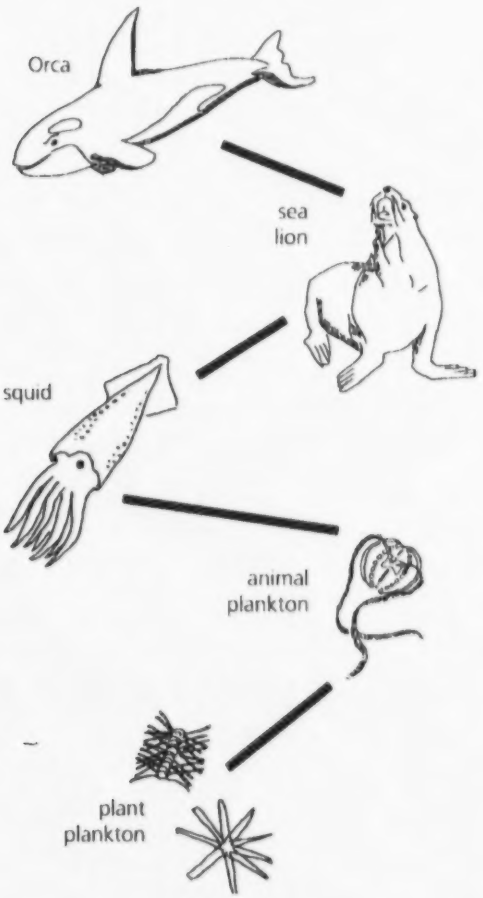


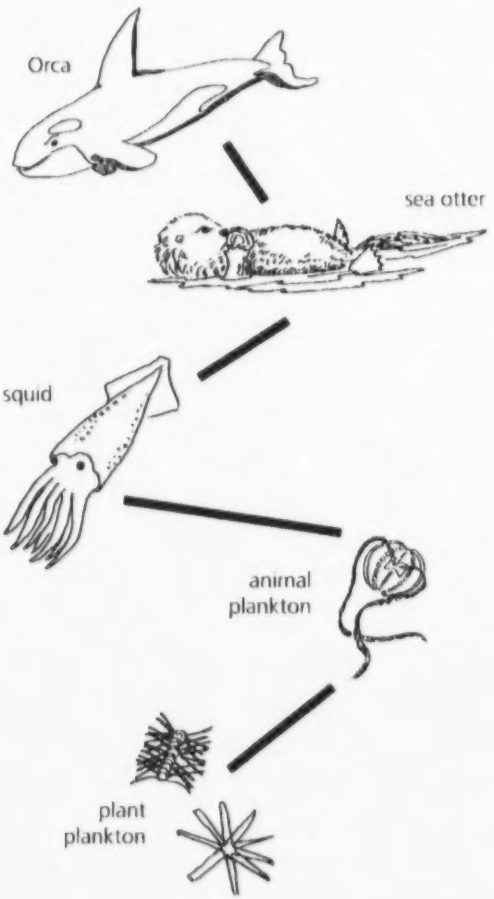
Student/Teacher Page

Everything in Nature is Connected

An example of this is a chain of ocean events in Alaska. Orcas, also called killer whales, hunt Steller sea lions as their main food source. A Steller sea lion is large and its layer of insulating fat gives the Orcas a high-calorie food source. But as the Steller sea lion populations decline, Orcas have begun feeding on sea otters. Sea otters are much smaller than Steller sea lions and do not have a layer of blubber. Therefore, it takes a lot of sea otters to fill a whale. Can you guess what the result has been? Sea otter populations have fallen drastically—as much as 25% per year.

Now that may not sound like a lot, but let's look at it this way: If you have 100 sea otters and 25% of them are eaten, how many sea otters have been killed? If you guessed 25 sea otters, you were right. Pretend your classroom is the number of sea otters in the wild. Figure out how many of your classmates would be left after the Orcas took their share?





Otters of the Ocean

Fun Fact:

To conserve body heat, a sea otter rests on its back, keeping its feet raised in the air, out of the cold water.

Sea otters are one of the top predators in the coastal ecosystem of the Northwest. They live in shallow water, rarely going more than a few miles from the shore. Sea otters are the slowest moving, least streamlined group of marine animals. Their bodies are encased in the densest fur in the world, which serves as their only defense against the cold ocean water.

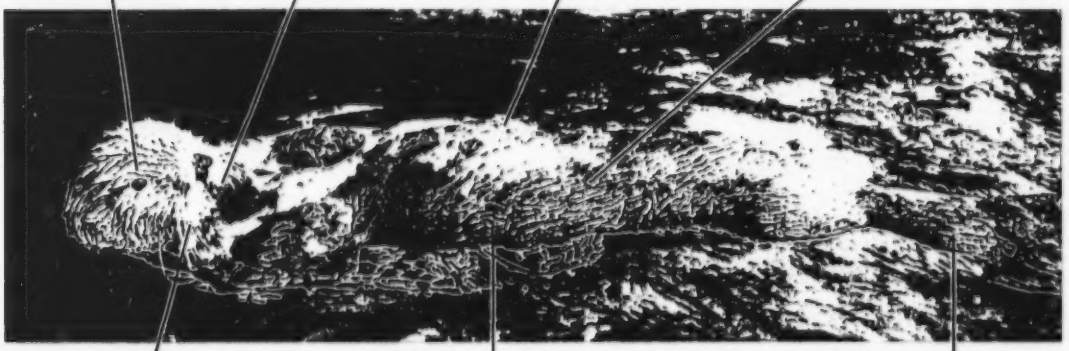
Their fur is so thick that cold ocean water cannot penetrate it. Sea otters' hind feet have developed to become webbed and flipper-like, but their front paws have remained like those of a land animal. Unlike seals, sea otters have no need to come to land, although they sometimes do. They have evolved to be able to live, breed, give birth and raise their young entirely in the water. Look at the drawing below to see some of the unique characteristics of the sea otter.

Their eyes see equally well above and below the water, making food easier for them to locate.

A sea otter's teeth are designed to crush hard-shelled animals, like abalone.

The fur of a sea otter is said to be the warmest in the world. It is water resistant and very dense.

Sea otter skin is very loose, allowing them to twist their bodies inside their skin to reach all parts of their fur for grooming.



Sea otters have a well-developed sense of touch in their **whiskers and their forepaws**, helping to guide them through murky water.

A sea otter has no **blubber** to keep it warm, making fur its only barrier against the frigid water.

Webbed hind feet propel them through the water.

Student/Teacher Page

Sea Otters and Their Tools

Perhaps the most fascinating adaptation that a sea otter has is its use of tools. Only a few other animals use tools and among them are people! Otters often use rocks under water to pry loose or bash stubborn abalone or sea urchins. On the surface of the water, seas otters are often seen placing rocks on their chests and pounding snails and other food items against the rocks. Rocks aren't the only tool otters use. They also make tools out of old shells, driftwood, crab shells and even empty glass bottles.

Photo by Tom and Pat Leeson

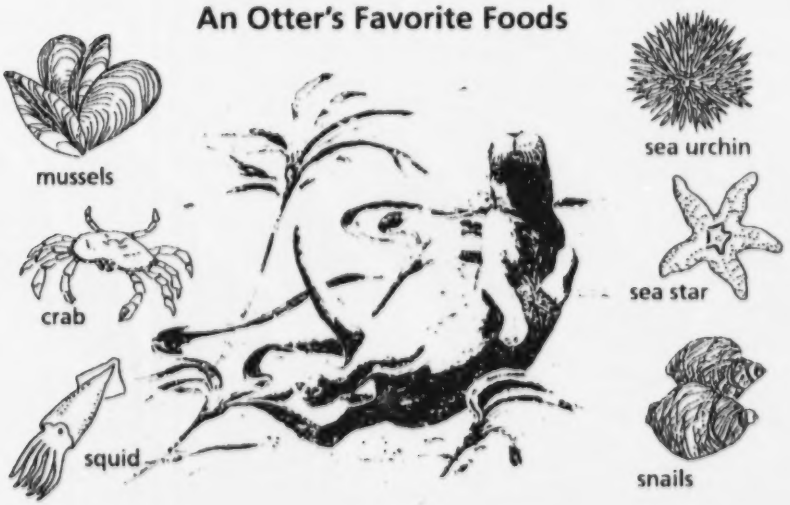
Sea otters are always learning and exploring new ways to find food. Marine biologists conclude that they learn very quickly and are good problem solvers. The usual diet of a sea otter is made up of abalone, rock crab, snails, sea urchins, octopus, mussels, clams and sea stars. Because sea otters need to eat large amounts of food each day, they must be on the lookout for different ways to get that food. Some otters actually look to people for handouts, although this is not a healthy way for them to eat. Some sea otters in California have learned to capture seabirds by grabbing their feet as the bird rests on the surface of the water. Another sea otter learned that small octopus often hide inside aluminum cans that people have thrown into the ocean. This otter would go from can to can in search of his next meal!

What types of tools do you use?

Fun Fact:

A sea otter burns calories very fast in order to keep warm; this means that a sea otter needs to eat 23 to 33 percent of its total body weight in food each day. If a sea otter weighs 60 pounds, how many pounds of food each day would he need to eat?

An Otter's Favorite Foods



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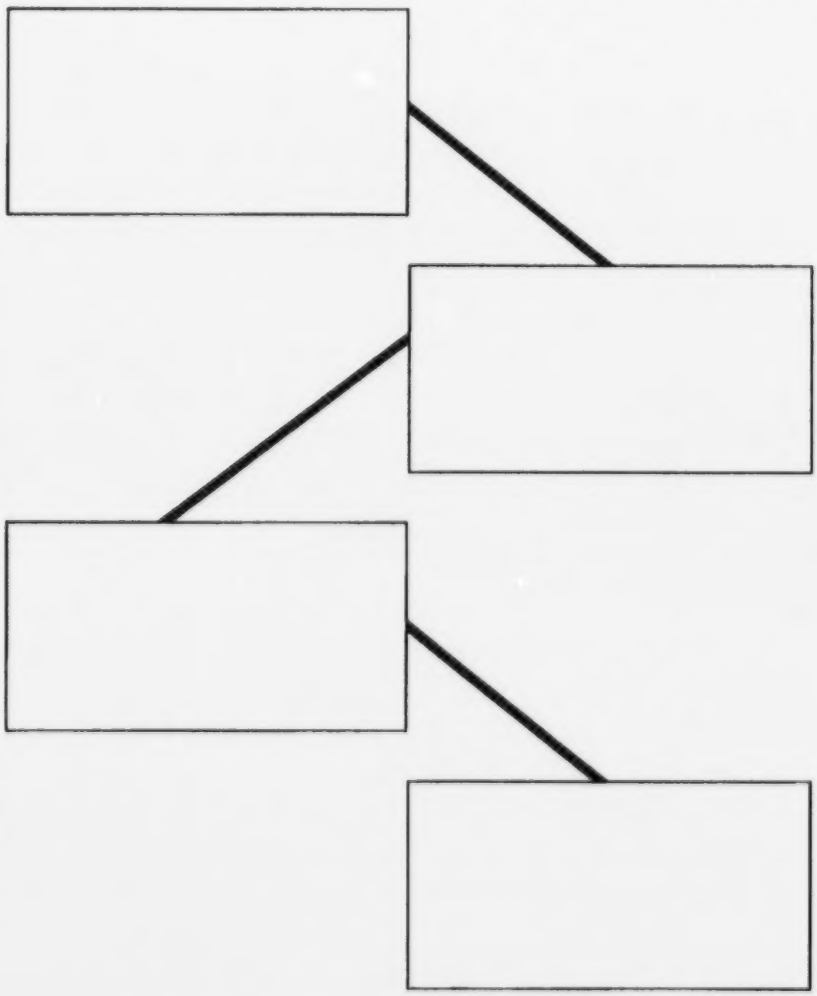
Kelp Forest: The Sea Otter's Home

Sea otters are found in kelp beds, forests of marine plants and animals that offer the sea otter a wide variety of food and a relatively safe environment. A kelp forest is made up of varieties of seaweed and kelp, plus an abundance of sea life. Like plants on land, giant kelp needs the sunlight that filters through the water to grow. A sea urchin feeds on giant kelp and other algaes. When sea otters eat sea urchins, the number of sea urchins is controlled so that they do not consume too much of the kelp forest. In this way, the sea otter is helping to keep the kelp forest alive. Once again, we see the connection between species and environment.

Fun Fact:

In order to keep from drifting away while they sleep, sea otters wrap themselves in the kelp forest's fronds.

Please fill in the following food chain using sea urchins, sea otters, sunlight and giant kelp



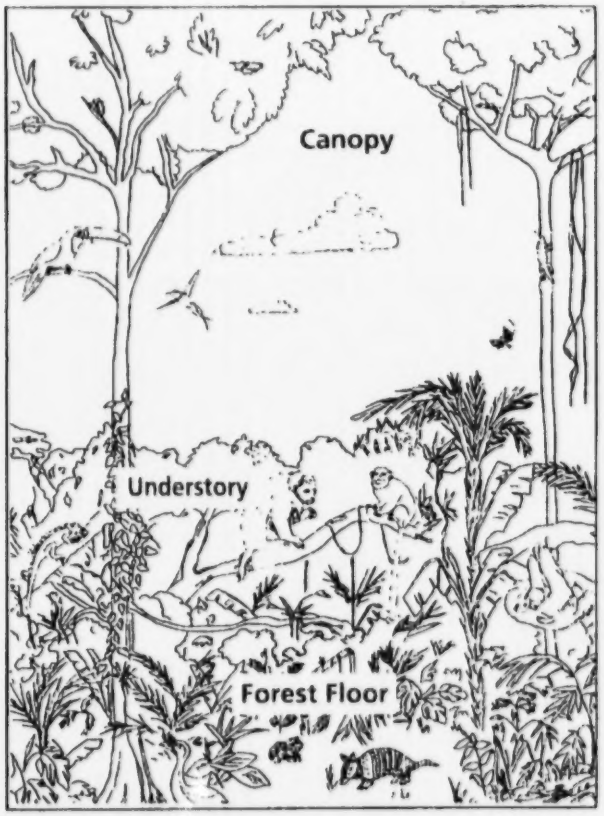
Student/Teacher Page

Kelp Forest vs. Tropical Rainforest

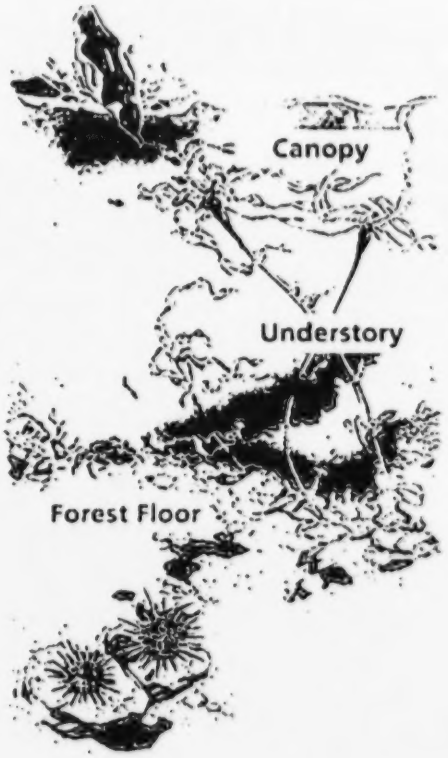
Although it may sound strange, a kelp forest has a lot in common with a rainforest. Both of these unique forests have layers, seasons and an abundance of plant and animal life. On land, tree roots go deep into the ground to get water and nutrients. As the trees grow they form canopies that shade the understory of the forest. Leaves and branches fall to the forest floor providing the soil with lots of nutrients while also supporting many smaller organisms. All of these factors combine to support a varied habitat for many animals.

A kelp forest is very similar. Kelp and seaweed anchor themselves in the ocean floor but get their nutrients from the seawater. Seawater has abundant nutrients that help kelp grow very quickly, but kelp does not live as long as trees. Like a land forest, kelp grows tall, forming canopies. The layers of the kelp forest are home to both predators and prey, each playing a part in the other's survival. Rainforests and kelp forests provide habitats for animals and support food webs.

Tropical Rainforest



Kelp Forest



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Kelp Forest Activities

* Activity *

Make your classroom into a kelp forest!
Objective: This lesson will allow students to research the layers of a kelp forest and the animals that are a part of each layer.

Materials: crepe paper in varied shades of greens and browns, construction paper, pens, pencils, scissors.
Procedure: Using the drawing of the layers of a kelp forest, design kelp and seaweed and kelp forest animals. Have students research different animals, being careful to have at least two animals per student for each layer. Hang large kelp from the ceiling or use your bulletin board to make a kelp forest. Have students place their animals in the kelp forest according to the layer in which they would be found. For forest floor animals, you may find it useful to tape the pictures to your classroom floor. This is a great activity that allows students to really envision what life in a kelp forest would be like.

* Activity *

Make a kelp forest diorama.
Objective: This lesson allows students to research and design a kelp forest.

Materials: cardboard shoebox, construction paper, crepe paper, glue, scissors, and pens
Procedure: Have students cut out kelp forest plants and animals and place them in their shoebox according to the layer in which they would be found. If space permits, ask students to label the plants and animals.

* Activity *

What if you were the last?
Objective: This lesson gives students the opportunity to use their creative writing skills to extend their understanding of kelp forest animals.

Materials: lined paper, pencil, and your imagination
Procedure: Ask students to choose a plant or animal from the kelp forest that has been covered in class. Tell students that they are going to write a story about the animal they have chosen, but their story needs to be about being the last of that type of animal. On the lined paper, have them write 'If I were the last _____ in the kelp forest . . .' Set the story length to fit student ability.

* Activity *

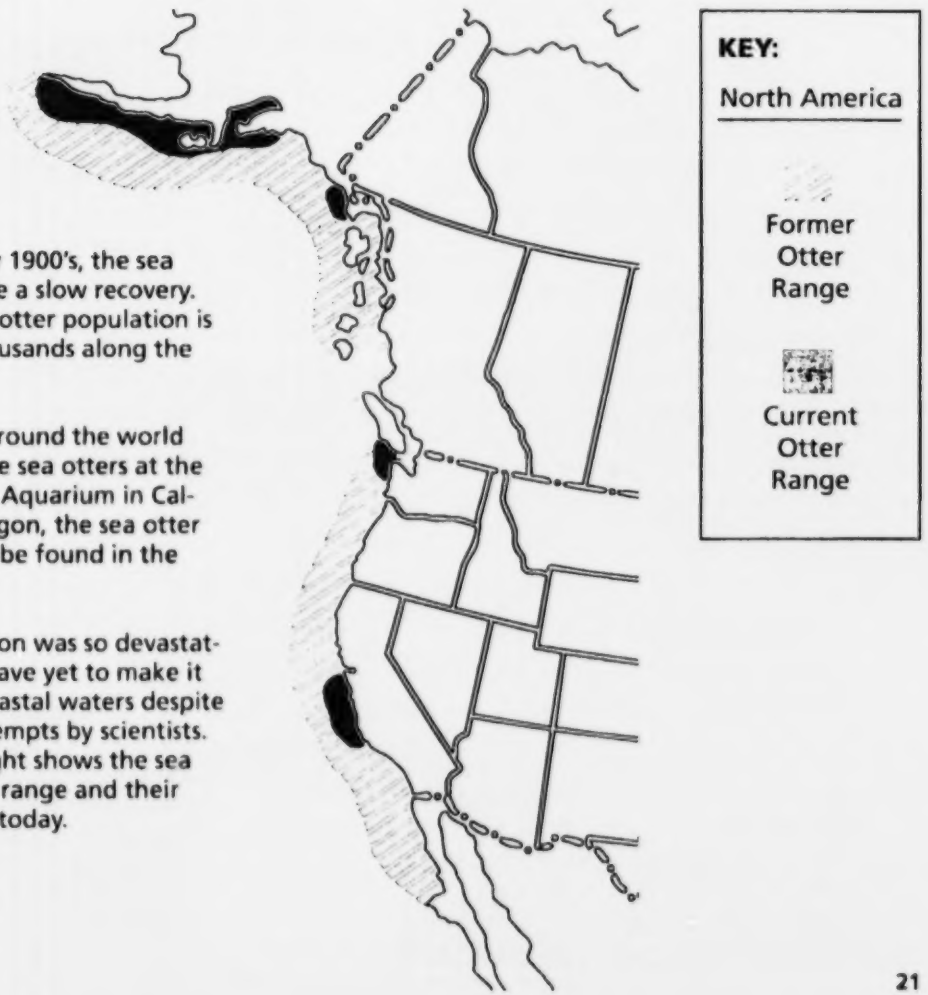
Predator and prey game.
Objective: This lesson gives students the opportunity to 'play a part' in the kelp forest ecosystem, enriching their understanding of the animal/plant relationships.

Materials: cut out student drawings of animals and plants in the kelp forest.
Procedure: Each student will represent an animal or plant in the kelp forest food chain (be sure students know what animals/plants they eat in the wild). Ask students to move about the room (you may also take this game outside) and play out what a day in the kelp forest would be like. Who would eat what? After a few minutes of this, remove one species of animal. How has the game changed? What do some predators need to do now? Keep removing different organisms as the game progresses until there is only one left. Discuss with students what happened as the game went on.

Student/Teacher Page

What Happened to All the Sea Otters?

Sea otters ranged up and down the west coast hundreds of years ago. Some scientists believe there were as many as 300,000 sea otters at one time. For hundreds of years, native people hunted sea otters for their fur, but it wasn't until the sea otter was commercially hunted that their numbers began to fall rapidly. Sea otter fur is the warmest in the world and because of that, commercial hunting companies hunted them in huge numbers. By the early 1900's, the sea otter was nearly extinct. Only 13 small colonies remained throughout the once vast range along the coast. In 1911, the International Fur Seal Treaty was signed and the sea otter was finally given the protection it so desperately needed.



Since the early 1900's, the sea otter has made a slow recovery. Today the sea otter population is in the low thousands along the west coast.

People from around the world flock to see the sea otters at the Monterey Bay Aquarium in California. In Oregon, the sea otter can no longer be found in the wild.

Their population was so devastated that they have yet to make it back to our coastal waters despite relocation attempts by scientists. The map at right shows the sea otters' former range and their current range today.

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What Happened to all the Sea Otters? *(cont.)*

Although sea otters are making a comeback, the threat to their survival is not over. In March 1989, the Exxon Valdez grounded off the Alaskan coast, spilling oil into the fragile waters of the Pacific Ocean. Ten million gallons of oil were released into the untainted waters of the Prince William Sound.

Sea otters, being very sensitive to the effects of oil contamination, suffered greatly. Hundreds of sea otters died as a result of the spill. Scientists worry that a spill like that off the California coast could decimate the California sea otter population.

Oil spills aren't the only threat. Sea otters compete with people for shellfish, leading to conflicts in the interests of the sea otters and the commercial fishing businesses. Shell fisheries and sea otters compete for the same food and this causes a problem for both the sea otter and the fisherman. One alternative that has been attempted by some fishing companies is the artificial cultivation of abalone, the sea otter's favorite shellfish. Do you think that this alternative can fix the problem? Why or why not? What do you see in the sea otter's future? Why do you think attempts at reintroducing sea otters to the Oregon coast have failed in the past?

Student/Teacher Page

What Happened to All the Sea Otters?

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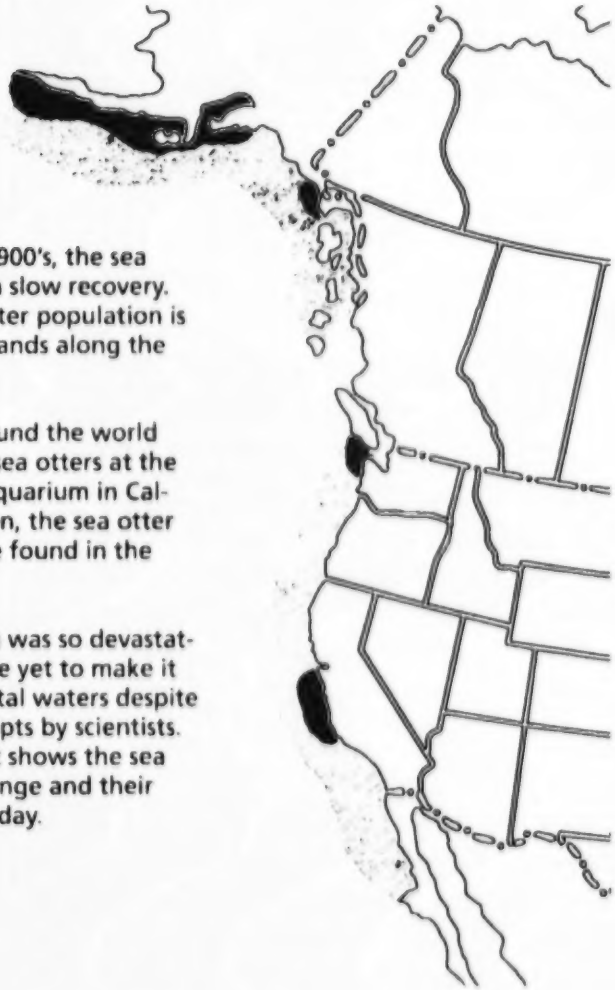
Sea Otter Range



KEY:

North America

Former Otter Range

Current Otter Range

Since the early 1900's, the sea otter has made a slow recovery. Today the sea otter population is in the low thousands along the west coast.

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Student/Teacher Page

All About the Zones

The spray zone is just what the name implies. It is the part of the tide pool reached only by the highest waves, ocean spray and rainwater. The plants and animals in the spray zone have adapted to retain moisture in their bodies, tolerate changes in salinity due to rainwater and survive extreme temperature changes. The spray zone contains fewer plant and animal species compared to the other tidal zones.

Fun Fact:

Many tide pool animals live on the sides of rocks where they are exposed to the sun, waves and wind.

These species have developed specialized ways of anchoring to the rocks.

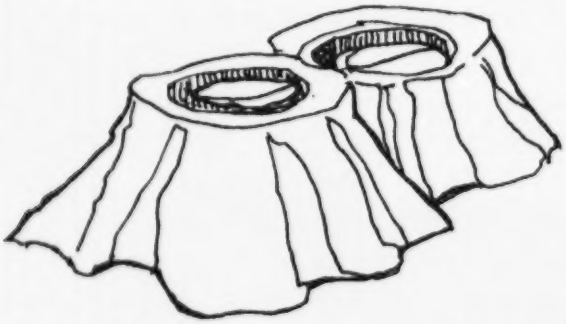
Barnacles cement themselves to the rocks, mussels anchor themselves with long, elastic threads and still others create suction to grip the rock.

***The checkered periwinkle** is an example of an animal that lives in the spray zone. These small, spiral snails will gather in the thousands in warm pools or moist crevices to graze on algal films. These spray zone animals are an important food source for birds and other predators who hunt in this zone.*

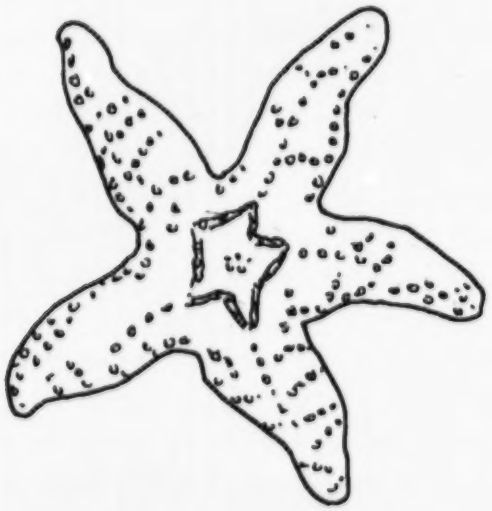
The high intertidal zone is covered only during high tides. The extremes in water availability, temperature and salinity are almost as extreme as the spray zone. The major difference in these areas is the heavy wave action that occurs. The plants and animals must therefore be able to attach themselves securely to rocks in order to avoid being washed away into the ocean.

All About the Zones *(cont.)*

An ***acorn barnacle*** *is the perfect example of an organism that has adapted to the high tidal zone. This barnacle often dominates the rocks and is an important food source for intertidal predators. Barnacles also provide shelter for hundreds of tiny animals and an anchoring place for various types of plants. They are prey for many high tidal zone animals like the whelk, a carnivorous sea snail that feeds primarily on barnacles.*



In the mid intertidal zone, tides cover and uncover this habitat twice a day. The changes in temperature and salinity are less severe in the mid tidal zone, enabling many more species of plants and animals to live here. Many of the animals living in this zone depend upon the waves to bring them their food. Within this zone are a great variety of animals that have adapted to survive in either the lower part of the mid intertidal zone or the higher portion.



The sea star is a sturdy, slow moving animal that has adapted to the mid intertidal zone. Hundreds of tube feet and a tough exterior aid this animal in withstanding the powerful waves that tumble into the mid intertidal zone.

The sea star feeds on barnacles, mussels and snails that thrive in this zone. The sea star plays an important role in the health of this intertidal zone by thinning out the mussel population.

All About the Zones *(cont.)*

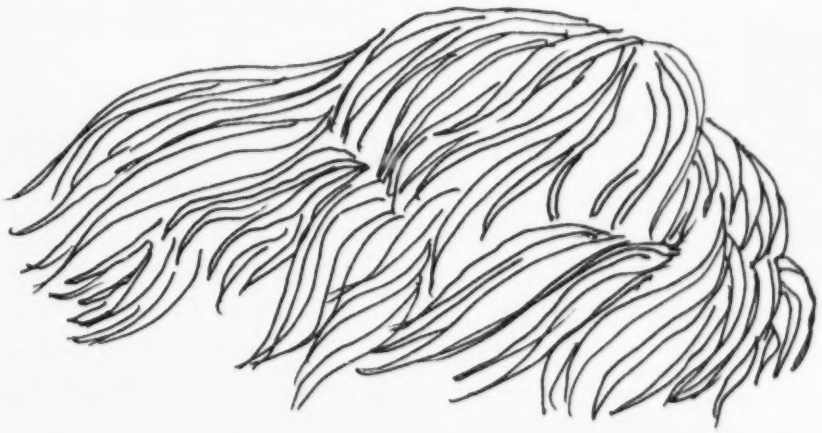
Water covers the low intertidal zone except at limited times during the lowest tides. The temperature and salinity changes in this zone are much less severe than in the other tidal zones. Many of the plants and animals in the low tidal zone can only survive for very short periods of time outside the water. In this zone, you can find the greatest variety of species including some types of fish.

Fun Fact:

Hermit crabs outgrow their shells, as they get older, forcing them to go in search of new shells.

These thieves will often find another hermit crab with a larger shell and strike a threatening pose. With their large claws waving, the two crabs will spar with each other.

When a crab admits defeat, it will leave its shell and quickly snap itself into the nearest shell it can find. The winner discards its old shell and curls itself into the new one.



In the populated low tidal zone you will find an abundance of plants and animals that are perfectly adapted to this unique habitat. ***Surf grass*** *grows in abundance in this zone, its emerald green leaves providing a maze of tunnels and crevices for many animals. The tide pool snailfish has adapted to use the surf grass, camouflaging itself in the tall leaves. This unusual fish feeds on small crustaceans that also live in this zone, like the kelp crab who feed primarily on rockweed and bull kelp.*

* Activity *

Make your own tide pool!

Objective: This lesson gives students a 'hands on' activity to demonstrate their knowledge of tide pool life.

Materials: air drying clay, sculpting tools, toothpicks, small square pieces of paper, glue, pencils, spray bottles to wet clay as needed, clay paint, small cup of water, plastic lid.

Procedure: Tell students that they are going to design a tide pool based upon the information from the last two pages of curriculum. Students can do this project in pairs or individually. Divide the clay into equal pieces and pass out to groups or students. Explain to students that they need to design their tide pool to include each zone plus a plant and animal for each zone. Have them do research prior to this to find plant/animal examples. Ask students to design the basic tide pool first, and then mold pieces of clay into the plants/animals to add to it later. To attach the plants/animals, make 'slip' out of the clay by mixing a small amount of clay with water in a plastic lid and dabbing it on the piece you want to attach. Be sure students label their tide pool zones. For each plant/animal, ask students to use the small square pieces of paper to write the name and a short description of the plant/animal, then glue the description to a toothpick. Place the toothpicks next to the plant/animal they represent while the clay is still soft.

Student/Teacher Page

Let's Visit the Tide Pools!

As in any natural area, good judgment and care must be taken when you visit a tide pool. The tide pool habitat is a fragile one and although many of the plants and animals that live here can withstand the force of waves, people easily damage them. Using just a few simple guidelines, you can enjoy Oregon's tide pools without endangering the fragile life that resides there.

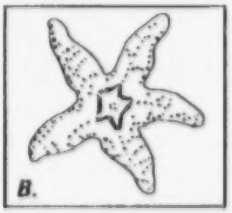
Photo by Patricia Galvin

We are the tide pool animals, please visit us and enjoy our unique habitat!

A. Hermit crab Walk with care—avoid stepping on us please!

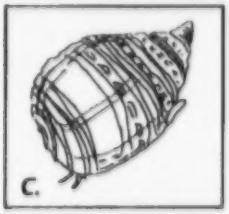
B. Sea star Examine us gently—pulling and prying us from the rocks can hurt or even kill us!

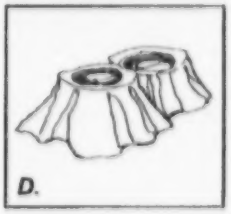
C. Sea snail Please don't move us from one place to another—we have adapted to live in a certain zone of the tide pool.



D. Barnacle If you move rocks to look at us, please put the rocks back where you found them, otherwise we could dry out!

E. Sea grass Take only memories, leave only footprints—please don't try to take us home with you, leave us in our habitat so that other people can enjoy us.





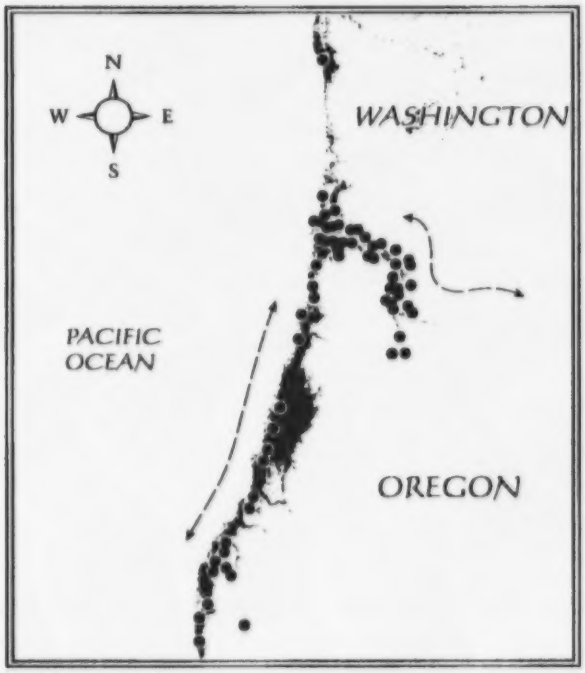
* Activity *

Objective: This lesson introduces students to useful guidelines when visiting natural areas.

Procedure: On the chart paper write 'Tide Pool Manners.' Ask students to brainstorm a list of guidelines that people should follow before entering a tide pool area. When you have completed your list, display the above guidelines on the overhead and compare to your list.

Student/Teacher Page

People of the Rocky Coast



For thousands of years, people have lived on and used the Northwest coast. Native people built their villages along the coast and developed their culture around the ocean and its bounty. Today, native people continue to pass down their heritage to younger generations, keeping their rich history and traditions alive. At left you will find a map of the historic villages of Northwest coastal native people.

* Activity *

What was their life like?

Objective: This lesson allows students to research Northwest native coastal people using a variety of research tools.

Materials: chart paper, marker, research tools (Internet, encyclopedias, CD-ROM's), note cards, paper, pencils, word processing computer (optional).

Procedure: On chart paper, brainstorm a list with students about the topics that would need to be covered in order to write a paper about the native people of the Northwest coast.

When the list is complete, distribute note cards to each student and ask them to write down the most important headings from the list that would make a complete paper (one note card per heading). Have students show you their note cards before they proceed, to ensure that they will be collecting enough material. Next comes the research. Use the Internet, encyclopedias and CD-ROM's to research the material. Each student should research and select one native tribe on which to base their paper. When note cards are complete, ask students to put them in an order that follows the basic writing order (introduction, supporting detail and conclusion). Students can then type their finished papers on the computer and publish them.

* Activity *

Archaeological digging

Objective: This lesson provides hands-on experience with archaeology and provides opportunity for critical thinking using deductive logic.

Materials: Several objects relevant to the lives of student's (pencils, small toys, packaged food items, small articles of clothing, etc.), digging tools, brushes, large tubs of sand or small roped off sections of the school playground, plastic bags, chart paper, markers.

Procedure: Divide students into two or more groups and have each group bury, in sand or in a small section of the school playground, objects relevant to their lives. It is important to keep these objects a secret from the other groups! Each group may then perform an "archaeological dig" at another group's burial site. When all items have been identified and cataloged, have them piece together information about the lives of the students who left those artifacts behind.

What You Do Makes a Difference

The rocky coast has existed for thousands of years. In order to preserve these fragile habitats, your help is needed. It is important for everyone to take responsibility for the coast, because we all play a part in its health and survival. Everything we pour down our drains and storm sewers, even fertilizers we put on our lawns, end up in the ocean. With this in mind, it's important for you to always be aware of things that may be harmful to life at sea. If you see a friend or neighbor changing the motor oil in his or her car and pouring the old oil into the sewer, where is that oil going to go? That's right, it goes into the ocean. Remind them that oil is very harmful to animals like sea otters and many other species as well.

Scientists are studying the effects people have on the coast and ways to prevent damage which threatens the coastline. One way the coast has been protected is through state laws. Some of these laws protect certain species, like the Steller sea lion, while others protect a fragile ecosystem. Without these laws, what do you think might happen? People play a big part in what happens to our coast. Fisheries must be careful that overfishing does not occur, causing a threat to some animals. On the shore, we need to be responsible in throwing away our garbage so that it doesn't end up in the ocean. Plastic bags are often mistaken for jellyfish by some seals and sea lions often resulting in death. It is important to be educated about what is happening on the coast today so that we can preserve it for tomorrow.

Fun Fact:

In order to protect the Steller sea lions at Orford Reef, a buffer zone was established to prevent sea urchin fishing boats from coming to close to the breeding ground.

What could you do to educate your neighbors and students at your school?

- Make informational posters that illustrate how harmful materials poured down a drain can hurt animals in the ocean.

- Write to Oregon Dept. of Fish and Wildlife and request information on products harmful to coastal animals and ways to prevent ocean contamination.

Can you think of any more ways you can help the plants and animals of the Northwest coast?

Student/Teacher Page

Visit the Oregon Coast at the Oregon Zoo!

Here at the Oregon Zoo, you have the opportunity to see our coast's unique habitats and animals. Our zoo is one of only four in North America that houses Steller sea lions. It is the zoo's goal to learn from these magnificent animals in order to better protect them in the wild. You will also find two sea otters, a beautiful pair who are sure to capture your heart! As you make your way through our Steller Cove exhibit, you will have the opportunity to see coastal native artifacts, a beautiful kelp forest and a tide pool teeming with life. Along the way, you can stop in our research center and learn about the latest efforts in the fight to save the Steller sea lion. All of these wonderful experiences are here at the Oregon Zoo!

What you can do at the zoo. . .

Journal Activity

Use a journal to take notes and make sketches of the animals and plants that you see in Steller Cove. Marine biologists use journals to keep a record of animal behavior, physical descriptions, drawings and notes about what they see. You can do the same when you visit the zoo.

Art Activity

Bring some paper and crayons or colored pencils and draw pictures of the plants and animals you see at Steller Cove. Maybe you'll want to concentrate on one part of the exhibit, like the kelp forest, or you may wish to make drawings of everything you see and then make a collage.

Photo by Patricia Gaye

Student Page

Zoo Worksheet

Name_____ **Date**_____

This fun worksheet is to be completed during your visit to the Oregon Zoo. You will find all of the information to complete the questions on your walk through Steller Cove. Have fun!

1. The Steller sea lion got its name from Georg Wilhelm Steller. When was Georg Steller born? How old was he when he died? What are the names of three animals that are named after Georg Steller?

2. In what season to Steller sea lions come ashore to breed and raise their young? In western Alaska, the Steller sea lion is an endangered animal. Is the Steller sea lion endangered in Oregon? What term is used to describe the Steller sea lion's status today?

3. Why are Steller sea lions an important species?

4. Where do sea otters give birth to their young? What animals do sea otters feed on? What has happened in Alaska with the Orcas, Steller sea lions and sea otters?

5. How many years have people lived on the Northwest coast? How many historic villages are there on the map? What is a midden? What can we find in middens?

Zoo Worksheet *(cont.)*

6. What happened to the sea otter populations in the past and why?

7. List four types of kelp forest animals/plants and include an example for each:

8. List the four tide pool zones and give at least three examples of plants/animals for each zone:

9. What do you think would happen to tide pool life if the ocean withdrew ten feet?

10. How might sudden changes in climate and ocean temperature affect tide pool life?

Student Page

Assessing Your Knowledge

Name_____ **Date**_____

Please answer the following questions using complete sentences. Include as much detail as possible.

1. Describe some of the marine adaptations that a sea lion has and how this benefits them in the wild.

2. What is a behavioral adaptation that a sea otter has? How does a sea otter use this adaptation?

3. Draw a sketch of a food chain for a sea otter.

4. Compare a kelp forest to a land forest.

5. List the four tide pool zones and include a brief description of how each zone is different from each other.

6. Write at least three ways that you can help protect the Oregon coast.

Teacher Resource Page

■ Books

Sea Searcher's Handbook by the Monterey Bay Aquarium Press
This book explores rocky shores, wetlands, sandy shores, kelp forests, the open sea and deep sea, where readers will meet fascinating creatures from playful sea otters to mysterious sharks. For ages 5-15, includes hands-on activities by marine educators, tested by 70,000 kids each year. Includes more than 100 illustrations, glossary and 90 kid-tested activities.
Paperback, 240 pp.
$16.95 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

The Adventures of Phokey the Sea Otter: Based on a True Story by Marianne Riedman, illustrated by Tony Lopez. The story of an orphaned sea otter in California's Channel Islands. Ages 8-12. Hardcover, 54 pp.
$14.95 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

Beneath the Waves by Norbert Wu.
An exploration of kelp forests for children ages 8-11 by the world-famous undersea photographer. Paperback, 48 pp. ISBN: 081181808X
$6.25 available at http://www.amazon.com or http://www.mbayaq.org.

Seashore Life on Rocky Coasts by Judith Connor.
Meet a cast of hundreds of plants and animals perfectly adapted to survive the pounding waves, drying sun and shifting tides of the emerald tide pools. A volume in the Natural History Series from Monterey Bay Aquarium Press. Paperback, 64 pp.
$9.95 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

Seals and Sea Lions by David George Gordon.
Explore the adaptations that make these fascinating marine mammals successful survivors in waters from the Arctic to the tropics. A volume in the Natural History Series from Monterey Bay Aquarium Press. Paperback, 64 pp.
$9.95 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

■ Videos

"A Sea Otter Story: Warm Hearts & Cold Water".
The story of the recovery of the Southern sea otter from near-extinction, and the Monterey Bay Aquarium's Sea Otter Rescue and Conservation program. 60 min. VHS cassette in NTSC (North American) format only.
$19.95 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

■ Web Sites

www.oregonzoo.org for information about the Oregon Zoo's Steller Cove exhibit, including information about seal lions, otters, kelp forests and tide pools.

http://www.pbs.org/wnet/nature/edgeofsea/html/tidepool.html to explore a virtual tide pool.

Teacher Resource Page *(cont.)*

http://www.aquarium.org/ for the Oregon Coast Aquarium web site. Includes information about pinnipeds, sea otters, kelp forests and coastal ecology.

http://www.mbayaq.org/ for the Monterey Bay Aquarium web site. Has information about pinnipeds, sea otters, kelp forests and coastal ecology. Special interactive features of the site include a live "kelp forest cam."

Internet search sites such as www.altavista.com, www.yahoo.com or www.google.com are also good ways to locate current informational web sites.

■ Miscellaneous

Kelp Forest Poster. A beautiful 36" x 22" illustrated poster by Larry Duke.
$15.00 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

Rocky Shores Poster. A beautiful 36" x 22" illustrated poster by Larry Duke.
$15.00 available at the Monterey Bay Aquarium online store at http://www.mbayaq.org.

■ Places To Go

Oregon Zoo
Steller Cove Exhibit
4001 SW Canyon Road
Portland, Oregon USA 97221
(503) 226-1561
http://www.oregonzoo.org

OMSI Science Camps
Camp Magruder and Camp Kimanilong offer optimal sites for the study of coastal ecology.
To receive a free catalog, write or call:
OMSI Registration Office
1945 SE Water Ave
Portland, OR 97214
Phone: (503) 797-4662, Fax: (503) 239-7800, Email: registrar@omsi.edu
http://www.omsi.edu/educprogs/camps/

Oregon Coast Aquarium
2820 S.E. Ferry Slip Road
Newport, OR 97365
Phone: (541) 867-3474 Fax: (541) 867-6846
http://www.aquarium.org/

Sea Lion Caves
91560 Hwy. 101 N.
Florence, OR 97439
Phone: (541) 547-3111 Fax: (541) 547-3545
http://www.sealioncaves.com/

U.S. Department of Education
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Educational Resources Information Center (ERIC)

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